my remarks in p. 63. My belief is now, as it has been for years (long before Mr. Stone's paper was published), that under favourable conditions an exceedingly fine ligament must be visible at the moment of real internal contact, the planet's outline being otherwise undistorted. But in most instances a coarser ligament is formed *not* contemporaneously with the moment of real contact. I have shown that the true moment of contact can be *inferred* from the formation of a coarser ligament as exactly as when a fine ligament is observed. This I still maintain, and I further believe that Mr. Stone's opinion as to the cause of the phenomenon, an opinion independently enunciated by myself in November 1868 (see *Scientific Opinion*) is correct, and that the experimental tests which have been supposed to disprove it, have in reality no sufficient bearing on the question at issue.

7. At p. 63. It is unfortunate if my account of Stone's proceedings suggests that I maintain he was the first to consider whether real or apparent contacts had been observed; for I have but lately been maintaining the contrary view in a correspondence with an ex-president of the Royal Astronomical Society. I have invariably opposed the opinion here ascribed to me. Mr. Stone himself has never claimed what I am said to have claimed for him. He has made a definite claim, and that claim I have repeated and still hold to be just.

Prof. Newcomb concludes with some general statements. He considers I am mistaken in supposing that astronomers generally regard observations on Venus in transit as the most trustworthy method of obtaining the solar parallax; mistaken again in supposing that Mr. Stone has removed any "difficulties that had perplexed astronomers;" and so on. Such statements are so vague that I shall scarcely be expected to discuss them. Until proof, or at least some evidence to the contrary, is supplied, I can only say that now, as when I wrote "The Sun," my opinions on these points seem to me to be just. I am certainly not alone in holding them.

RICHARD A. PROCTOR

Brighton, September 23

Elementary Geometry

THE question raised on this subject naturally consists of two parts. The first relates to the unsuitableness of Euclid as a text-book, and the need of a work which shall so commend itself to examiners and teachers, so to supplant it. The second question is —given the authoritative text-book, how is the geometry of which it treats to be taught to young students? The arguments on the first of these questions have been so ably and conclusively stated lately by several mathematicians, especially by Mr. Wilson, Dr. Joshua Jones, and Dr. Hirst, that there is no need to revive the discussion; but I entirely agree with your correspondent in his conclusion that the book which is to supplant Euclid is at present a desideratum, and that it will probably be the work of more heads than one. Several books have been written during the last four years, and have formed the basis of the discussions which have since taken place on the requirements of the new programme. By their means, the questions at issue between the opponents and supporters of Euclid have become more clearly defined, and a greater unanimity of action has resulted amongst those who are labouring to supply this desideratum of modern education. But I am sure that most of these authors will admit that the issue of works intended for permanent text-books was premature.

When the first question is settled, the second remains. Geometry is not essentially difficult, nor is it generally distasteful to young students. It becomes so, however, when they are required to commit the propositions to memory before they understand them. The educational purpose which geometry serves is not the discipline and exercise of the memory. A choice and pregnant passage from a good author may be learnt and retained in the memory without much difficulty, although its meaning may be very imperfectly understood, and it will richly repay the labour of its acquisition. It will be recalled again and again, and receive new light, and afford new pleasure with every fresh association. Not so with geometry; it is useless if not understood. A child should be made to comprehend even the definitions before he commits them to memory. Let us suppose, for instance, that the definition of a circle is to be learnt, the preliminary explanation should take some such form as the following.

The teacher at the black-board, with chalk and compasses, and the pupils at their desks, with paper and compasses—the teacher draws a circle and names the figure—he tells each boy also to make a circle, and then proceeds to question. What name is given to such a surface as that on your drawing paper? What kind of a figure shall we call one which can be drawn on a plane surface? Compare a triangle and a circle, and say how many lines form the boundary of the triangle? How many lines contain the circle? Explain exactly what you do with the points of the compasses when you use them to make a circle? Why must the joint of the compasses be tight? Fix a drawing-pin in your drawing-board, and with a piece of thread construct a circle. What purpose does the thread serve in the construction? The defining properties of a circle are, therefore, these—(1) it is a plane figure; (2) it is bounded by one line, termed the circumference (3); every point of the circumference is at the same distance from a fixed point, termed the centre.

After the definition is worded in its permanent form, and repeated, and written several times on paper, it will be remembered.

Again, let us suppose the propositions on the equality of triangles to be the subject; the following introductory questions and exercises suggest themselves. Draw two straight lines, one 5 in. long, and the other 8 in.; then make with your protractor an angle of 43°. Construct a triangle having one of its angles equal to the angle drawn, and the sides of this angle equal to the given straight lines. Take the figures drawn by different boys, and compare them as regards size. Now consider the parts of each; how many sides has each? How many angles? How many sides are drawn from given dimensions? Letter them and then name them. How many angles? Name it. How many angles were not originally given? Name them. How many sides? Name it. Compare this third side, B C, in two of the figures. If the figures are all accurately drawn throughout the class, what must necessarily follow with regard to this third side B C in all the figures, &c.?

Finally, the proposition should be enunciated, and the proof learnt in the form in which it is to be remembered.

Then the teacher may give three angles which may form the angles of a triangle, and when the constructions are made compare two figures from distant parts of the class. Similarly he may treat all the allied propositions. When taught in this way, the subject becomes so easy and attractive that it may be commenced at an early age.

If, as some teachers maintain, Spartan severity be necessary to secure mental discipline, then this plan of teaching elementary geometry will not be an improvement on that of forcing into the memory Euclid, pure and simple, without note or comment; but when the test of success is applied, I am sure the plan of making the early school work as easy and as pleasant as possible will require no other argument to support it.

R. WORMELL

Deschanel's "Heat"

IT is remarkable that Prof. Everett asserts *h* to represent the reduced height of the mercurial column, when the *unreduced* height is carefully indicated in Fig. 264 by the same symbol *h*. Moreover it is distinctly stated on page 362 that "the tension of the vapour is evidently equal to the external pressure minus *the height of the mercury in the tube.*"

Prof. Everett writes, "In some instances I have endeavoured to simplify the reasonings by which propositions are established or formulæ deduced" (Preface, part 1). This would lead most people to expect simplicity, which includes accuracy; and they may well be astounded when they find not only unexplained but inaccurate formulæ. Prof. Everett's promises, and not his complaint, were the grounds of expectations which have not been realised.

THE REVIEWER OF DESCHANEL'S "HEAT"

Sept. 22

Newspaper Science

MR. FORBES does not stand alone in his experience of newspaper science. The *Globe*, however, is not generally looked on as a scientific paper, and no one would be likely to go to it for information on matters other than political. What shall we say, however, to the following paragraph, copied *verbatim et literatim* from the columns of the *Mark Lane Express* for September 4?—

"CHARLOCK.—A correspondent inquires what he must do to abate the annoyance of it in his crops. We do not believe there is any mode of preventing its presence. Some seasons are distinguished by its appearance. We do not think they come from

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seed, but is the result of some electrical action producing them spontaneously. The late Duke of Portland used to say they need not sow white clover where bones were used freely; and where the pure white lime is used, clovers are seen without sowing seed. Also, if, as may be seen any season on the roads of Derbyshire, where the roads are repaired with white limestone, the clovers are present by the side of the wheel-tracks. The same may be seen on laying land down to permanent grass. Use farmyard manures, and the coarser grasses are seen; use road-scrapings and compost, and the finer grasses are sure to come. The charlock is an unwelcome visitor; but its removal in corn crops is often worse than the evil itself. 'Let both grow together till the time of harvest.' The seed has more value than some suppose, and when crushed will be found a good tonic. Nothing is given to us in vain."

Comment in this case also is needless. One hardly knows which most to admire in this rich paragraph; the independence of the trammels of the ordinary rules of syntax displayed by the writer; the teleological moral drawn at the end; or the contempt for science manifested in the assertion of the possibility of so highly-organised a plant as the charlock arising "spontaneously" in the ground. When such lamentable ignorance of the very elements of science is displayed by those who should be the leaders, what can we expect from the farmers themselves? Well may we exclaim, *Quis docebit ipsos doctores!*

Alfred W. Bennett

London, Sep. 23

ICE FLEAS

THE water flea, *Daphne pulex*, is a well-known inhabitant of rivers and fresh-water lakes, and, being distinctly visible to the naked eye, often attracts the attention of water drinkers. Though a harmless crustacean, this little creature not only excited great interest in parliamentary committees during the last session, but exercised a very powerful influence over the choice of a water supply for the northern capital of Great Britain. The ice flea, if known at all, is certainly less celebrated, and probably by no means likely to be so potent in its parliamentary influence; nevertheless a short account of it may not be wholly uninteresting to the readers of NATURE.

During a recent ramble upon the Morteratsch Glacier, I turned over some of the isolated stones which lie upon its surface partially imbedded in the ice; under many of them I found hundreds of a minute jet black insect, which jumped many times its own length at a single spring, in a manner somewhat resembling the performance of a common flea.* The ice flea is about one-twelfth of an inch long. Viewed through a pocket lens, it was seen to have six legs, supporting a body obscurely jointed like that of a bee, and furnished with two jointed antennæ. The total length of the insect appeared to be about six times its thickness, the antennæ being about one-fourth as long as the body. The insects were not found under every stone, they generally occurred under flattish fragments of rock, presenting a surface of about a square foot, and having a thickness of from 2 to 4 inches. Stones of this size are sufficiently warmed by the sun's rays to melt the ice beneath them more rapidly than it is liquefied by the direct solar beams. A surface of rock absorbs luminous thermal rays better than does a surface of comparatively white ice, and it transmits these rays to the ice beneath it, partly by conduction and partly by radiation from its under surface. The stone thus melts its way an inch or two deep into the ice, forming for itself a kind of basin. Sometimes these cavities are watertight, and then any space between the stone and the walls of its basin are filled with water derived from the melting ice. Under such conditions I have never found any fleas beneath the stone. But occasionally the ice basin is drained, and it was under stones resting in such comparatively dry basins that the insects were found. In all cases nearly the whole of the fleas were found upon the ice, very few being attached to the stones. They were grouped together in shoals, so that probably forty or fifty of them frequently rested upon a single square inch of ice. On removing the stones, the insects were very lively, but this might be owing to their sudden transition from comparative darkness to direct sunlight.

I saw no indications of food of any kind beneath the stones, indeed these insects must have a struggle for existence of a most severe character. Living in an atmosphere the temperature of which never rises above the freezing point, they must be continually exposed to inundations during the day by the stoppage of the drainage of the ice basin, whilst on clear nights severe frosts frequently threaten them with an icy grave. Again, during the day the roof of their habitation is, as it were, continually falling in upon them, and thus constantly exposing them to the risk of being crushed to death; for, as the ice melts beneath the stone, the latter is continually changing its points of support. It may be, however, that the crystalline structure of the ice causes it to melt with a corrugated surface, which provides everywhere valleys of sufficient depth to protect the fleas from destruction by the fall of the superincumbent mass of rock. We have also not to search far for a possible source of food. The cold of the glacier benumbs and kills thousands of insects which alight upon its surface, and bees, wasps, flies, and moths are frequently seen dead upon the ice. Then there is the so-called "red snow," and other allied organisms of similar habits, which may perhaps minister to the wants of this singular insect. Is the ice flea, like its irritating cousin, a nocturnal predatory insect, and does it issue from its dangerous abode at nightfall in search of frozen bees and butterflies? Perhaps some of the entomological readers of NATURE may be already acquainted with this animal, and be able to supply further information respecting it.

E. Frankland

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[*] My friend Prof. Eschenburg, of Zürich, had previously observed these insects on the Morteratsch Glacier, and it was his verbal account of them that led me to search for them.

REMARKS ON PROF. WILLIAMSON'S NEW CLASSIFICATION OF THE VASCULAR CRYPTOGAMS

IN discussing the points at issue between Prof. Williamson and myself, it will be necessary for me to say a few words on stems in general, because we evidently have very different views of the construction of stems; and until we thoroughly understand each other, it is impossible for us to come to any definite conclusions. In a young dicotyledonous stem (see Oliver's "Lessons," p. 112, fig. 67) we find three things: a quantity of cellular tissue surrounded by an epidermis, and near the centre a series of young fibro-vascular bundles. As growth goes on, these separate bundles coalesce and form a central cylinder of united fibro-vascular bundles. These bundles leave a portion of the cellular tissue in the middle of the stem, which becomes the pith. Outside the fibro-vascular bundles we have also a small quantity of the cellular tissue, but it soon becomes to a great extent inseparable from the sub-epidermal cells. Other portions of the cellular tissue remain between the united fibro-vascular bundles, and form the medullary rays. In many stems and in most roots these rays are wanting, and the cellular tissue would therefore be divided into two portions by the united bundles. Each fibro-vascular bundle consists of two portions, which are separated by a layer of cells capable of division, the cambium. On the inner side of the cambium cells we have in general spiral vessels; porous vessels, and wood cells, while on the outer side we have the soft bast and bast fibres. The epidermis is soon thrown off in many cases, and is replaced by layers of cork-cells

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